strong fluid for such delicate algæ, and there was evidently much shrinkage of the material, as shown in the outlines of the text figures. These latter are not satisfactory, considering the importance of the details which are discussed, and in the opinion of the reviewer are not convincing. There are some fundamental principles concerned in the discussion between Oltmanns and Davis which will require more thorough investigation before final conclusions are likely to be reached. The most important of these concern the history of the developing oogonium after the multinucleate stage, and the factors that lead to the selection of the nucleus which comes to preside over the egg.

BRADLEY M. DAVIS.

HOLOTHURIANS

Holothurioidea.[1]—Under the above title Östergren has made a noteworthy contribution to the literature concerning the Holothurioidea. Based upon years of special study of the group, he concludes that in order to estimate the value of an organ in taxonomy and phylogeny, the function of the organ must be completely understood.

Ostergren first discusses respiration, particularly in connection with the enteron as respiratory organ. By means of their dilator muscles, sometimes the œsophagus, but most often the cloaca, functions as a pump to force the water into other parts of the enteron, or into especially developed extensions of the same. The primitive condition is found in the Synaptidæ.

In most of the Elasipoda respiratory trees are lacking, and yet the cloaca is provided with dilators, and doubtless functions as a pump to force water into the enteron. As Ludwig (1889–92) points out, in various members of the Elpidiidæ and Psychropotidæ, a simple unpaired evagination appears as a "rudimentary gill," or water-lung. From such a beginning comes the single, or double, stemmed respiratory trees. Since it is possible to have within a natural genus certain species without water-lungs, others with them rudimentary, and still others with well-developed respiratory trees, Östergren maintains that the presence, or absence, of these organs is of no particular importance in taxonomy.

[1] Östergren, Hjalmar. Zur Phylogenie und Systematik der Seewalzen. Särtryck ur Zoologiska Studier tillägnade Professor T. Tullberg. Upsala. October 12, 1907.

The pedicels have not the same importance for locomotion in sea-cucumbers as in sea-urchins and star-fishes. The sea-cucumber moves by worm-like contractions of the parts of the body. The pedicels on the part temporarily at rest either suck hold of the solid bottom or bore into the slime, and thus serve to give a firm basis from which the other parts of the body may be extended. Östergren (1897) proves that the anchor-like spicules of the Synaptidæ are locomotor. Even in the pedate holothurians, the spicules help to make a firm anchorage for the resting part of the body while the moving part is bent away from the bottom and thus the rough points made by the spicules do not hinder the forward movement. Some sea-cucumbers, like the remarkable Pelagothuria, swim, and in them the pedicels are small and weak.

On the other hand, the Dendrochirotæ, which remain for a long time in one spot, have well-developed pedicels so that they can suck fast to rocks, or algæ, or on soft bottom, burrow into the slime and by means of their suckers ballast themselves with stones and fragments of shells. The pedicels often gather weeds and shells which form a protective mask. In holothurians without pedicels, the spicules serve for this protective function. In very different groups spicules of the same form, albeit actually fundamentally different, may be developed without indicating any natural relationship of the groups. Such, for instance, are the anchors of the Synaptidæ, and the Molpadiidæ. The branching of the calcareous rods is always in a manner best adapted to form the spicule with economy of material.

While admitting that pedicels and tentacles are homologous as external appendages of the ambulacral system, Östergren claims that they are distinctly different, with no connecting links between, and therefore, like Perrier (1902), declines to follow Ludwig's (1889–92) characterization of the Synaptidæ as having tentacle-feet, and no body-feet. On the other hand, he does not follow Perrier in classifying the Molpadiidæ as apodous, but considers the anal papillæ as reduced pedicels which, like similar appendages in the Aspidochirotæ and Dendrochirotæ, have evolved as tactile organs.

Ludwig (1891) proves for one of the Dendrochirotæ, *Cucumaria planci,* and the present writer has shown (Edwards, 1889, 1905) for one of the Aspidochirotæ, *Holothuria floridana,* that the tentacles develop from the radial canals in the same manner

as the pedicels. Furthermore, in *Holothuria floridana* at first the tentacles are provided with terminal suckers and these organs, like the primitive pedicels, are used for locomotion, while in feeding, as in the adult, they push food into the mouth. Admitting that the distal anal papillæ are modified pedicels, I think it is reasonable to consider the proximal oral tentacles as pedicels, only much more modified in the adult, for their special functions.

Östergren imagines the primitive form, or "Stammholothurie," as having had a soft body-wall containing spicules, and with five simple radial muscle bands, interrupting the transverse sheet of muscle. It moved by contractions of the body, and ate slime. The stone-canal was simple and opened on the outside of the skin. There were many pedicels and either ten or twenty tentacles without ampullæ. The calcareous ring had five radialia and perhaps five interradialia. The enteron was in three loops, the third in the right ventral inter-radius. The blood system did not expand into a *rete mirabile*. The posterior end of the enteron developed as a respiratory cloaca but respiratory trees were not present. There were no auditory vesicles. Östergren's primitive form was most nearly related to the present Elasipoda, and from it he shows how the five chief divisions of the class Holothurioidea may have evolved. Östergren employs as the names of these orders, Elasipoda, Aspidochirota, Dendrochirota, Molpadonia and Apoda (Synaptidæ, Chiridotidæ and Myriotrochidæ), and then concludes with a general description of the chief characters of each order.

CHARLES L. EDWARDS.

THE ENTEROPNEUSTA

Recent Literature on the Enteropneusta. 1. *Systematic.*—Spengel has lately given the classification of the Enteropneusta a thorough overhauling.[1] This accepted imperator in the knowledge of the group recognized at the time 31 species, 9 genera and 3 families. Since then 14 species and one genus have been added. Nearly all the new ones have come from the Pacific and Indian Oceans, these two enormous reservoirs of unknown organisms, the exploration of which has but recently begun in earnest. R. C. Punnett's report, The Enteropneusta in the "Fauna and Geography of the Maldive and Laccadive Archi-

[1] Die Benennung der Enteropneusten-Gattungen. *Zoolog. Jahrb.*, 15 Bd., pp. 209–218, 1901.